Demography India
Vol. 49, No. 2 (2020), pp. 52-66 ISSN 0970-454X

Dynamic Life Table: A District Level Study for Some Selected States of India

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Abstract: In the present study, we tried to construct a dynamic life table at the district level by incorporating the rate of change of the death probabilities which is merely absent in the period life table. A comparison between the dynamic life expectancy at birth and the corresponding usual expectation of life at birth by sex and regions under consideration is also laid out in the given study. Through this study, we have made an effort to systematically analyze the mortality pattern over the years at the micro-level in India by constructing the life tables under the dynamic set. Analysis of mortality data is immensely important particularly in the Indian context where there is a wide disparity in death statistics by age, gender, and geographical regions. Results in this study highlighted the difference between the dynamic LEB and the corresponding periodic LEB deviates with the choice of the region. The gap between the dynamic and periodic expectation of life at birth by sex also showed inconsistent estimates for a similar region.

Keywords: Districts, Dynamic life expectancy, India, Life expectancy.

Introduction

The analysis of mortality trend and pattern since the emergence of the Sample Registration System (1970) depicts that India's mortality has followed a downward trend over the last few decades with some variation in the pace of decline across decades (Saikia, 2016). But still, the transition of mortality is divided into two stages viz., rapid improvement in expectation of life during the year 1970 to 1990 and then followed by a relative stagnation from 1990 to mid-2000 as pointed out by Chaurasia (2010) and Saikia et.al (2011). An upswing in the life expectancy in the country has resulted mainly by the reduction and stagnation of under-five mortality in both stages. Due to this reduction, the expectation of life at birth during the year 2009-13 is around 67.5 years which is about 17.8 years more than life expectancy at birth for the period 1970-75. This resulted in an average escalation of around 0.47 years annually under the current period or an average rise of nearly 2.4 years per quinquennials. All such estimates are easily available from the life tables published by the Registrar General of India annually. The life table describes the mortality of a hypothetical birth cohort and can summarize that experience in terms of life expectancy at birth (LEB) i.e., an average number of years lived by the members of the life table cohort (Schoen and Romo, 2005). It is a key summary tool for assessing and comparing mortality situations prevailing in a population (Igwenagu, 2014). Typically, there are two forms of life tables-cohort and period life table. A period life table is based on the mortality experience of an entire population during a relatively short period of time (Bell et. al, 1992). The

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period life table is constructed considering that there is no further reduction in the mortality rates. However, this fact diverges as the records in many developing and developed countries reveal a continuous decline in mortality. So, the concept of dynamic extension of the period life table was proposed by Denton and Spencer which would allow explicitly for the possibility of further declines (Denton and Spencer, 2011). The dynamic extension of the period life table reflects the implications for survivorship and life expectancy of the observed mortality probabilities of a given period in addition to the observed rates of change of those probabilities under the assumption that the rates of change remain constant.

The concept of dynamic tables was addressed by very few researchers in the literature. Denton and Spencer (2011) for the first time developed the concept of the dynamic framework as an extension of the period life table and applied it to Canadian data for the year 2001 based on the rate of change of probabilities of death over the previous 10, 25, and 50 years. Further, the calculated dynamic life expectancies are compared with the published period life expectancy taken from Statistics Canada life tables for 2001. Based on the findings of the study, they pointed out that the differences between the period and dynamic life expectancies fluctuate with the selection of historical period but for children, young adults, and middle-aged adults the differences are substantial in all cases. Sharma et.al (2017) for the first time constructed the dynamic life tables for India and some of its major states for the period 2006-2010 based on the rates of change of death probabilities over the previous 10, 25, and 50 years for both the sexes. Their findings indicated that in all the three intervals i.e., 10, 25, and 50 years, amongst all the selected states Kerala witnessed higher dynamic life expectancy at birth for both the sexes. But unfortunately, no dynamic life table has been constructed so far at the district level of India.

Studies in the literature reveal that India has been undergoing substantial demographic change since 1970 (Guruprasad, 2015). Dyson (2008) mentioned that the demographic transition of the country has been started with a reduction in the average death rate from 1920 onwards. The increased control of many infectious and parasitic diseases like smallpox, malaria, the spread of immunization coverage, progress in improving sanitation and water supplies, increased level of education in the population, a considerable expansion of health facilities has led to the sustained improvement in mortality (Dyson, 2008). In India, infant mortality rates also have shown a steady and secular decline over the years while life expectancy has continued its upward climb (Chatterjee, 2009). In addition to this, mortality among adults has also been declining steadily and significantly across the states of India (Yadav and Arokiasamy, 2010). As per the official bulletins published by the Registrar General of India, it is evident that the crude death rate at all India level has been fallen from 14.9 per one thousand population to 12.5 from 1971 to 1981 and thereafter from 9.8 to a low of 7.1 from 1991 to 2011. Among the major states, it is noticed that the death rate in Uttar Pradesh in the year 2013 has declined by 13.8 points from 1970-75. Similarly, death rates in other states like Assam which stood at 17.2 in 1970-75 went down to 7.8 in 2013. Kerala showed a decline of 2.1 points from the period 1971 to 2013. This suggests that the level of mortality tended to vary significantly across the states of India (Navaneetham and Krishnakumar, 2011). Many studies have examined the trends and patterns of mortality across time and regions in India (Preston and Bhat, 1984; Jain et al., 1985; Roy and Lahiri, 1987; Bhat and Naveentham, 1991, Visaria, 2004). Chaurasia (2006) has also studied the mortality trend in the urban areas covering the period 1971-2002 and concluded that the rate of decline in urban male mortality has been slower than that of urban female mortality in India. All

these studies showed that mortality rates do not remain the same over the years but this supposition is not accounted for in the period life table. It is vital to study the pattern of mortality over the years existing in the micro level as districts are the important units of administration. Further, there are no studies found at the district level of India that made an effort by incorporating continuous changes in mortality. So, in this context, the dynamic life table is a requisite tool to reckon the changes in mortality over the years in the districts of a developing country like India. We have chosen districts, particularly from the three states namely Assam, Kerala, and Uttar Pradesh. Assam being the North-Eastern state, Kerala the most demographically developed state, and Uttar Pradesh is the socially economically disadvantaged and most populous state; we have chosen these states so that we can bring out a clear picture of the mortality variation existing within and outside the state of the country.

Objective

In the present study, an attempt has been made to construct the dynamic life tables for both the sexes at the district level of the selected states of India namely Assam, Kerala and Uttar Pradesh for the period 2011 based on the rate of change of the probability of death over the past 10 years.

Data

The necessary data needed for the study are the district-wise life tables based on the periods 2001 and 2011**.** The life tables for India and its major states are provided by the Sample Registration System (SRS). But for the smaller areas, the life tables are not readily available. So, one needs to construct the life tables at the micro-level by indirect estimation. Choudhury and Sarma (2011) constructed the district-wise life table for females by using the regression approach. Two sets of regression models have been exploited. First by taking the expectation of life at birth $\left(e_0^0\right)$ as independent variable and expectation of life $\left(e_x^0\right)$ at ages 1, 5, 10 and so on have been input as the dependent variable and secondly expectation of life at birth $\left(e_0^0\right)$ as an independent variable and the probability of deaths $\left({}_nq_x\right)$ at ages 0, 1, 5 and so on as the dependent variable. After obtaining the ${}_nq_x$ and e_x^0 at different age groups, the other life table functions are calculated. Similarly, life tables for males at the district level based on the census year 2001 are constructed. District-wise life tables for both the sexes for the subsequent census year 2011 are also generated using a similar approach.

In order to construct a dynamic life table for 2011 based on the 2001 census, we need to make some adjustments. As per the 2011 census, Assam had 27 districts while at the time of 2001 census, the state had 23 districts. The new districts namely Baksa, Chirang, Kamrup Metropolitan, and Udalguri were created during the 2011 census. Similarly, in Uttar Pradesh, there were 70 districts according to 2001 census while during 2011 census, one more district namely Kanshiram Nagar has been created. Details of the newly formed districts are given in Appendix A1. Thus, the life tables for each of the new given districts have been adjusted with the districts that were carved out from the indigenous districts. The adjustment of the districts has been made under the assumption that there is a very negligible change in the mortality pattern between the districts that has been bifurcated from the native districts.

Methodology

The modus operandi given by Denton and Spencer (2011) in the context of the dynamic life table has been adopted in the current study. For the construction of a dynamic life table, it is a prerequisite to have the period life tables for two periods that are *t* years apart. The more recent life table is taken as the reference period life table. Now, if ${}_nq_x$ denotes the probability of death for the age group [*x*, *x*+*n*) in the reference period and the corresponding probability in the earlier period is ${}_n\bar{q}_x$ (in our context, 2011 is the reference period and 2001 is the earlier period), then the annual rate of change of the death probabilities for any age group [*x*, *x*+*n*) is given by

$$ {}_nr_x = \left({}_nq_x \Big/ {}_n\bar{q}_x \right)^{1/t} - 1 $$

Now, let l_{xx} denotes the cohort of the reference period and l_{xy} represents the population of initial age group *x* to *x*+*n* that survived to the age group *y* to *y*+*n*. Then the probability that a member of the l_{xx} cohort who has alive to the exact age *y* will die in the interval *y* to *y*+*n* is given below:

$$ {}_nq_{xy} = {}_nq_y \left(1 + {}_nr_y\right)^{y-x} $$

where ${}_nq_y$ is the death probability in the age group [*y*, *y*+*n*) in the reference period, ${}_nr_y$ is the annual rate of change of that probability and *y*-*x* is the number of years between the subsequent age and initial age group and thus the number of years over which the age *y* probability has changed . Once we get the death probabilities under the dynamic set up, the remaining columns of the life table can be obtained in a similar procedure as it is done in the period life table. Hence, finally, the dynamic life expectancy at age *x* is calculated in the following manner:

$$ e_{xx} = T_{xx} \Big/ l_{xx} $$

where T_{xx} is the total number of person-years yet to be lived by the l_{xx} cohort.

Results and Discussion

For the sake of saving the space, instead of all the columns of dynamic life tables, we are presenting the dynamic life expectancies at birth (Refer Table 1 to Table 3). For comparison purposes, the corresponding usual life expectancy at birth for the period 2011 for the districts of the selected states are also given in the tables (Table 1 to Table 3). To display the estimates in a more compact manner, maps are created by using the *ArcGIS Software* (Refer Figure 1 to Figure 3). The Table indicates that in Nagoan district of Assam according to the dynamic calculations, a newborn male child has a life expectancy of 66.97 years at birth while a female child has 65.30 years. As per the periodic calculations, the values stood at 59.76 years and 63.06 years for males and females respectively. This district is found to have the highest life expectancy at birth under the dynamic scenario amongst the 23 districts (after the adjustment made) of Assam while the Kokrajhar district showed the lowest position with 56.15 years for males. On the contrary, the periodic calculations depicted the districts namely Tinsukia and Hailakandi as the highest and

lowest rank with 62.08 years and 56.89 years. In the case of females, based on dynamic calculations, Jorhat is found to have the highest expectation of life at birth with 74.34 years while Kokrajhar is at the lowest with 61.36 years. Same districts also showed the highest and lowest position according to the periodic calculations with 68.13 years and 55.87 years (Refer to Table 1). This witnessed a difference of 6.21 (5.49) years between the periodic and dynamic expectation of life at birth in the Jorhat (Kokrajhar) district. As can be viewed from Figure 1, the districts from Upper Assam like Jorhat, Lakhimpur, Tinsukia, Dibrugarh, Sibsagar, and Golaghat have scored higher values of LEB under the dynamic set up amongst the males as compared to the districts from the Lower Assam region. But this is not true for the Dhemaji district from Upper Assam. Districts like Kokrajhar, Dhubri from the Lower Assam fared comparatively worse as the longevity of the males from those regions is less than 60 years. In the case of females, all the districts from the Upper Assam division have scored the LEB of above 65 years under the dynamic consideration.

Out of a total of 14 districts in Kerala, the highest expectation of life at birth under the dynamic consideration occurred in the Malappuram district with 85.13 years (Refer to Table 2). This exhibits a difference of 12.48 years with the periodic LEB amongst the males. On the contrary, the lowest dynamic LEB is found in the Thrissur district with 72.51 years which is 0.42 years more than the periodic LEB estimate. In the case of females, Pathanamthitta district ranked the highest position (90.89 years) with respect to dynamic calculations while Ernakulam district is in the lowest position with 80.39 years. As can be viewed from Table 2, Pathanamthitta and Kasaragod showed the highest and lowest position for females as per periodic calculations which is 9.64 years and 7.14 years less than the dynamic LEB estimates.

Furthermore, in Uttar Pradesh amongst the 70 districts, the highest male dynamic LEB occurred in Gautam Buddha Nagar with 65.69 years, which is 2.15 years more than the expectation of life at birth by periodic calculations. The lowest male dynamic LEB is found in the Farrukhabad district with 57.22 years. This showed a negative difference of 0.28 years with respect to usual life expectancy at birth. On the other hand, dynamic LEB among the females is the highest in Gorakhpur district with 70.89 years while the lowest occurred in Sitapur district with 60.85 years. This showed a difference of 4.37 years and 3.62 years with respect to periodic calculations. Amongst the four regions of the state namely Western, Central, Bundelkhand, and Eastern, it is found that about 42.85 percent of the districts (Jalaun, Jhansi, and Hamirpur) from the Bundelkhand region (Refer to Table 3 and Figure 3) have dynamic LEB for males above 64 years while for females all the districts from this region have scored above 64 years. Except for Lucknow, other districts particularly Sitapur, Hardoi, Unnao, Rae Bareily from the Central region have scored very low value (less than 61 years) for males while for females, only Kanpur Nagar and Lucknow (70.51 years and 69.60 years) districts exhibited a better performance in comparison to other districts of the same region (Refer to Figure 3). Comparing the districts of Western and Eastern regions, about 22.22 percent of the districts (6 out of 27) from the Eastern region have the expectation of life at birth amongst the males below 60 years as per the periodic calculations while for the Western region, 23.08 percent of the districts (6 out of 26) belong to this interval (<60 years). As per the dynamic calculations; only 15.38 percent of the districts from the Western region have the longevity for males above 64 years while the corresponding figure for the Eastern region is 14.81 percent. In contrast to this, a larger number of districts (31 percent) from the Western region are found to have the expectation of life at birth amongst the

males under the dynamic scenario less than 61 years while 22.22 percent of the districts are from the Eastern region (Refer to Table 3). It is also noteworthy to mention that a wide regional disparity is observed in the Western region in terms of dynamic LEB for males. For instance, a male from the Bijnor district of this region have the expectation of life under the dynamic set up for only 57.94 years which is 7.15 years less than the male from the Mahamaya Nagar district of the same region. In the case of females, a higher percentage of the districts (22.22 percent) from the Eastern region have scored the LEB under dynamic consideration above 68 years in comparison to the districts from the Western region (15 percent) (Refer to Table 3 and Figure 3). The analysis showed a huge regional imbalance within the state. In addition to this, it is also noticed that amongst all the districts of the selected states under consideration, only the districts of Kerala showed outstanding performance in terms of life expectancy at birth under the dynamic set up for both the sexes in comparison to the other districts. While, on the other hand in the state Uttar Pradesh, most of the districts (21.43 percent) showed a negative difference between the dynamic LEB and periodic LEB among the males. The corresponding percentage of the districts amongst the females stood up at 1.43. Sharma et. al (2017) in their study also found a negative difference between the dynamic and period LEB among the males for the state Uttar Pradesh for the period 2009-13 based on the rates of change of probabilities of death over the previous 10 years (1999-2003).

Table 1: Comparison between periodic LEB for 2011 and dynamic LEB based on the rates of change of death probabilities over the previous 10 years for the districts of Assam

Districts	**Males**			**Females**		
	Period LEB $\left(e_0^0\right)$	**Dynamic LEB** $\left(e_{00}^0\right)$	$e_{00}^0 - e_0^0$	**Period LEB** $\left(e_0^0\right)$	**Dynamic LEB** $\left(e_{00}^0\right)$	$e_{00}^0 - e_0^0$
1.Kokrajhar	57.97	56.15	-1.82	55.87	61.36	5.49
2.Dhubri	57.97	58.21	0.24	59.05	65.94	6.89
3.Goalpara	60.17	61.51	1.34	61.2	66.94	5.74
4.Barpeta	60.17	61.52	1.35	60.46	64.22	3.76
5.Morigoan	58.70	63.65	4.95	60.53	65.47	4.94
6.Nagoan	59.76	66.97	7.21	63.06	65.30	2.24
7.Sonitpur	60.35	63.44	3.09	59.75	63.80	4.05
8.Lakhimpur	61.45	64.53	3.08	64.09	66.00	1.91
9.Dhemaji	61.55	61.92	0.37	64.80	66.95	2.15
10.Tinsukia	62.08	64.38	2.30	66.28	68.66	2.38
11.Dibrugarh	61.70	63.44	1.74	67.28	67.84	0.56
12.Sibsagar	60.74	63.89	3.15	66.99	68.16	1.17
13.Jorhat	61.65	64.82	3.17	68.13	74.34	6.21
14.Golaghat	60.76	63.74	2.98	66.2	66.61	0.41
15.Karbi Anglong	58.95	61.84	2.89	60.1	66.96	6.86
16.Dima Hasao	61.19	62.39	1.20	65.31	67.20	1.89
17.Cachar	60.67	62.50	1.83	65.13	66.61	1.48
18.Karimganj	58.51	62.42	3.91	61.45	67.06	5.61
19.Hailakandi	56.89	58.90	2.01	60.81	66.69	5.88
20.Bongaigaon	60.25	60.29	0.04	65.28	67.07	1.79
21.Kamrup	60.71	61.59	0.88	65.34	67.56	2.22
22.Nalbari	61.91	63.18	1.27	67.58	68.91	1.33
23.Darrang	58.19	61.47	3.28	61.89	67.04	5.15

Table 2: Comparison between periodic LEB for 2011 and dynamic LEB based on the rates of change of death probabilities over the previous 10 years for the districts of Kerala

Districts	Males			Females		
	Period LEB $\left(e_0^0\right)$	Dynamic LEB $\left(e_{00}^0\right)$	$e_{00}^0 - e_0^0$	Period LEB $\left(e_0^0\right)$	Dynamic LEB $\left(e_{00}^0\right)$	$e_{00}^0 - e_0^0$
1.Kasaragod	71.76	80.76	9.00	74.64	81.78	7.14
2.Kannur	73.26	79.14	5.88	78.28	89.76	11.48
3.Wayanad	70.86	81.93	11.07	74.97	84.54	9.57
4.Kozhikode	73.99	81.84	7.85	76.82	85.55	8.73
5.Malappuram	72.65	85.13	12.48	75.43	85.21	9.78
6.Palakkad	72.57	78.82	6.25	75.85	83.57	7.72
7.Thrissur	72.09	72.51	0.42	78.86	81.33	2.47
8.Ernakulam	72.47	72.52	0.05	77.97	80.39	2.42
9.Idukki	71.40	79.40	8.00	74.69	85.39	10.7
10.Kottayam	75.75	76.24	0.49	80.38	81.34	0.94
11.Alappuzha	73.58	74.18	0.60	80.20	83.87	3.67
12. Pathanamthitta	77.66	81.73	4.07	81.25	90.89	9.64
13. Kollam	73.35	76.19	2.84	78.88	89.74	10.86
14.Thiruvananthapuram	70.71	72.66	1.95	75.92	86.62	10.70

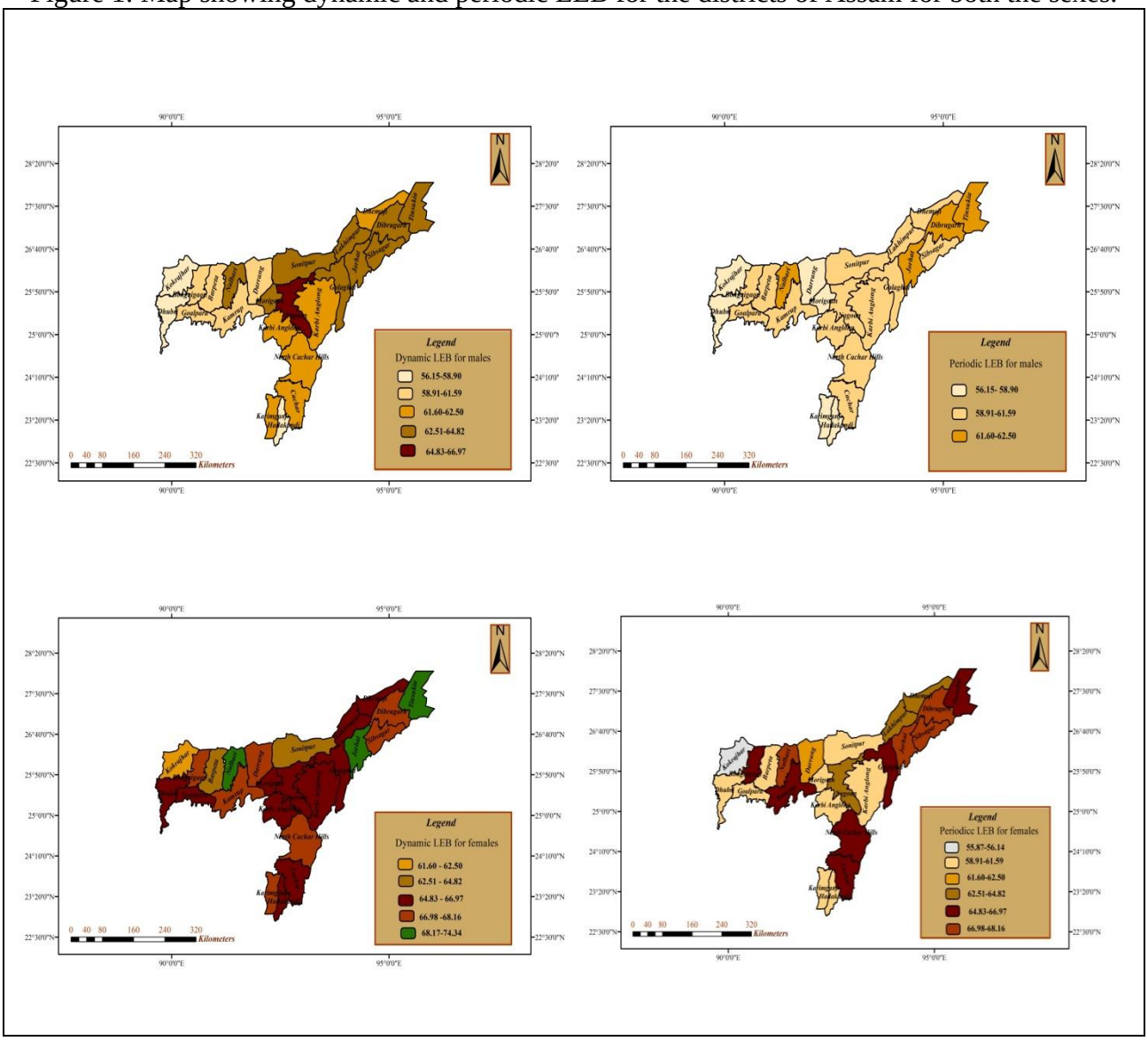
Table 3: Comparison between periodic LEB for 2011 and dynamic LEB based on the rates of change of death probabilities over the previous 10 years for the districts of Uttar Pradesh

Districts	Males			Females		
	Period LEB $\left(e_0^0\right)$	Dynamic LEB $\left(e_{00}^0\right)$	$e_{00}^0 - e_0^0$	Period LEB $\left(e_0^0\right)$	Dynamic LEB $\left(e_{00}^0\right)$	$e_{00}^0 - e_0^0$
1.Saharanpur	61.57	61.35	-0.22	61.46	64.8	3.34
2.Muzaffarnagar	61.18	60.27	-0.91	62.25	65.20	2.95
3.Bijnor	58.98	57.94	-1.04	60.43	63.25	2.82
4.Mordabad	59.15	60.25	1.10	60.28	64.76	4.48
5.Rampur	60.2	61.11	0.91	61.99	67.08	5.09
6.Jyoti Phule Nagar	60.14	61.19	1.05	61.31	65.35	4.04
7.Meerut	62.97	63.00	0.03	65.44	67.52	2.08
8.Baghpat	63.28	60.56	-2.72	65.75	66.67	0.92
9.Ghaziabad	63.22	63.94	0.72	64.53	67.09	2.56
10.Gatutam Buddha Nagar	63.54	65.69	2.15	65.50	68.30	2.80
11.Bulandshr	60.44	61.41	0.97	61.43	66.27	4.84
12.Aligarh	61.26	62.68	1.42	61.50	66.37	4.87
13.Mahamaya Nagar	63.69	65.09	1.40	65.39	70.14	4.75
14.Mathura	61.35	59.73	-1.62	61.58	64.23	2.65
15.Agra	63.51	64.95	1.44	64.68	69.73	5.05
16.Firozabad	62.34	63.99	1.65	61.56	66.65	5.09
17.Mainpuri	60.99	61.49	0.50	59.02	61.58	2.56
18.Budaun	58.47	60.60	2.13	57.18	63.43	6.25
19.Bareily	59.62	61.22	1.60	59.18	64.11	4.93
20.Philibit	60.07	62.73	2.66	59.18	65.46	6.28
21.Shahjahanpur	59.94	62.41	2.47	59.05	64.42	5.37
22.Kheri	59.26	61.63	2.37	58.21	62.72	4.51

23.Sitapur	58.28	59.32	1.04	57.23	60.85	3.62
24.Hardoi	58.70	60.97	2.27	57.48	62.36	4.88
25.Unnao	59.50	60.75	1.25	60.93	64.83	3.90
26.Lucknow	63.25	64.51	1.26	67.27	69.60	2.33
27.Rae Bareily	59.66	60.46	0.80	62.53	66.40	3.87
28.Farrukhabad	57.50	57.22	-0.28	60.71	65.00	4.29
29.Kannauj	61.43	62.72	1.29	62.13	66.22	4.09
30.Etawah	63.60	63.45	-0.15	65.27	67.14	1.87
31.Auraiya	62.05	60.27	-1.78	65.65	69.18	3.53
32.Kanpur Dehat	61.6	63.25	1.65	63.24	67.39	4.15
33.Kanpur Nagar	62.75	61.69	-1.06	66.84	70.51	3.67
34.Jalaun	64.61	64.83	0.22	68.06	69.25	1.19
35.Jhansi	63.35	64.86	1.51	66.99	70.06	3.07
36.Lalitpur	66.87	62.61	-4.26	61.57	66.67	5.10
37.Hamirpur	63.22	64.65	1.43	64.05	66.58	2.53
38.Mahoba	61.75	62.39	0.64	63.17	66.17	3.00
39.Banda	61.98	62.68	0.7	63.17	67.29	4.12
40.Chitrakoot	61.50	62.74	1.24	60.68	64.96	4.28
41.Fatehpur	60.37	61.23	0.86	61.01	65.18	4.17
42.Pratapgarh	61.54	60.32	-1.22	63.76	66.69	2.93
43.Kaushambi	57.75	58.00	0.25	59.14	63.79	4.65
44.Allahabad	59.99	61.41	1.42	59.54	64.27	4.73
45.Bara Banki	57.56	57.71	0.15	58.83	63.05	4.22
46.Faizabad	60.36	58.25	-2.11	62.40	64.59	2.19
47.Ambedkar Nagar	60.96	58.54	-2.42	63.57	66.01	2.44
48.Sultanpur	61.96	61.81	-0.15	64.22	67.53	3.31
49.Bahraich	59.22	61.13	1.91	59.67	64.66	4.99
50.Shrawasti	60.31	61.34	1.03	57.84	63.27	5.43
51.Balrampur	59.93	61.79	1.86	58.36	63.84	5.48
52.Gonda	62.36	63.13	0.77	62.87	66.69	3.82
53.Siddharthnagar	60.75	62.29	1.54	61.93	66.81	4.88
54.Basti	61.69	61.78	0.09	63.40	66.77	3.37
55.Sant Kabir Nagar	62.14	63.53	1.39	65.08	68.95	3.87
56.Mahrajganj	59.43	59.92	0.49	61.45	65.55	4.10
57.Gorakhpur	63.41	64.77	1.36	66.52	70.89	4.37
58.Kushinagar	59.55	59.88	0.33	61.78	62.05	0.27
59.Deoria	63.82	63.29	-0.53	67.56	68.36	0.80
60.Azamgarh	63.74	64.38	0.64	67.77	69.59	1.82
61.Mau	61.35	62.45	1.1	63.91	64.90	0.99
62.Ballia	63.07	64.54	1.47	66.12	66.74	0.62
63.Jaunpur	61.97	62.25	0.28	64.81	67.87	3.06
64.Ghazipur	60.82	62.26	1.44	62.55	63.13	0.58
65.Chandauli	64.37	65.3	0.93	65.36	69.30	3.94
66.Varanasi	62.55	63.64	1.09	59.81	68.70	8.89
67.Sant Ravidas Nagar (Bhadohi)	60.18	61.28	1.10	60.16	64.11	3.95
68.Mirzapur	60.42	61.09	0.67	63.68	63.23	-0.45
69.Sonbhadra	61.74	63.69	1.95	59.77	67.26	7.49
70.Etah	62.01	64.04	2.03	59.77	65.77	6.00

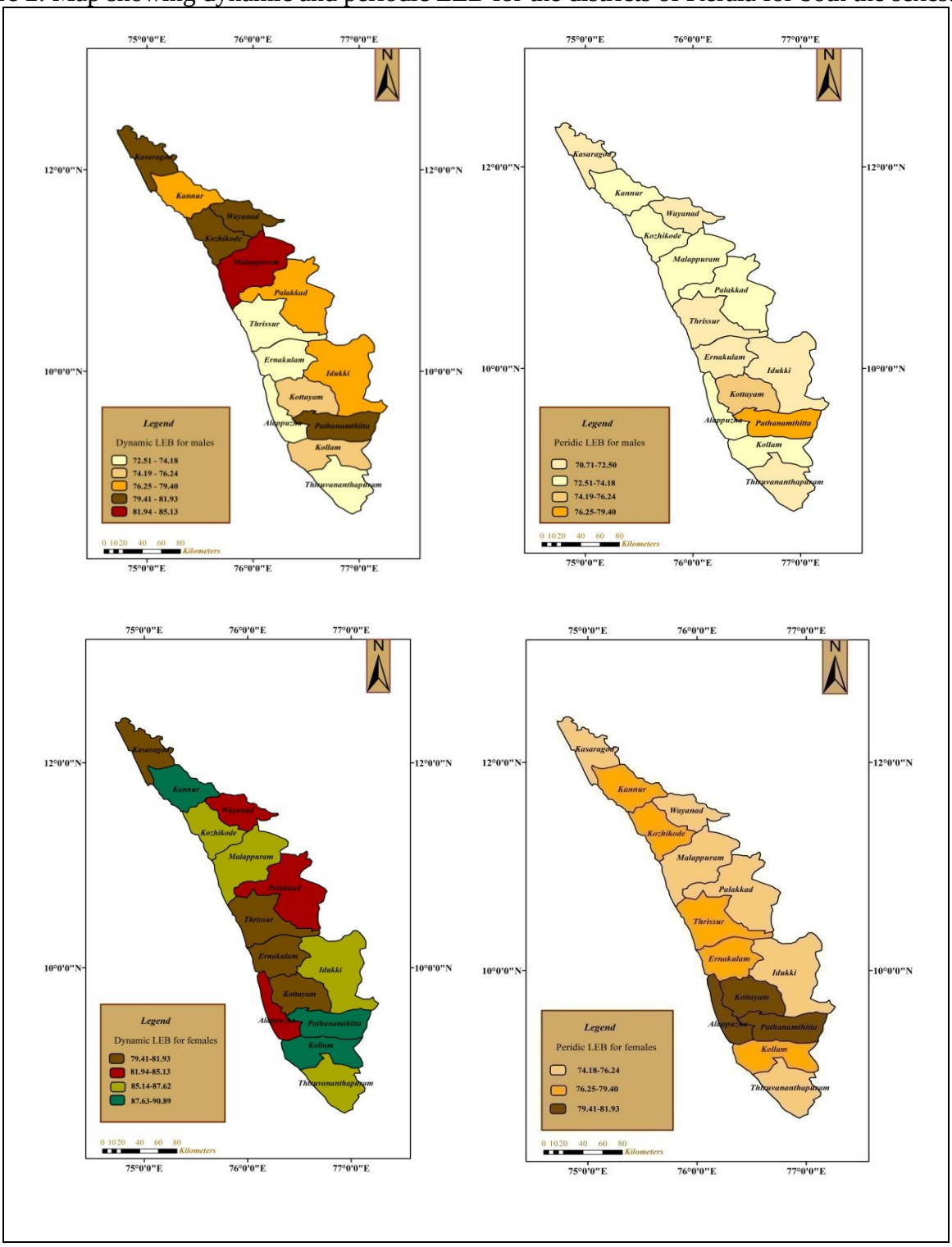
(###*Note:* **(1).*Western U.P.districts*:** Baghpat, Bareilly, Badaun, Agra, Mathura, Moradabad, Ghaziabad, Bulandshahr, Meerut, Saharanpur, Aligarh, Muzaffarnagar, Rampur, Shahjahanpur, Jyoti Phule Nagar, Gautam Buddha Nagar, Etah, Firozabad, Mainpuri, Bijnor, Farrukhabad, Philibit, Mahamaya Nagar, Kannuaj, Etawah and Auraiya. **(2). *Eastern U.P districts:*** Bahraich, Balia, Basti, Gonda, Allahabad, Kushinagar, Shrawasti, Balrampur, Kaushambi ,Gorakhpur, Maharajganj, Deoria, Azamgarh, Mau, Varanasi, Chandauli, Jaunpur, Ambedkar Nagar, Sultanpur, Faizabad, Ghazipur, Mirzapur, Sonbhadra, Sant Ravidas Nagar, Sant Kabir Nagar, Siddharthanagar and Pratapgarh. **(3) *Central U.P. districts:*** Kheri, Sitapur, Hardoi, Unnao, Lucknow, Rae Bareily, Kanpur Dehat, Kanpur Nagar Fatehpur and Bara Banki. **(4) *Bundelkhand U.P districts:*** Jalaun, Jhansi, Lalitpur, Hamirpur, Mahoba, Banda, Chitrakoot.)

Figure 1: Map showing dynamic and periodic LEB for the districts of Assam for both the sexes.



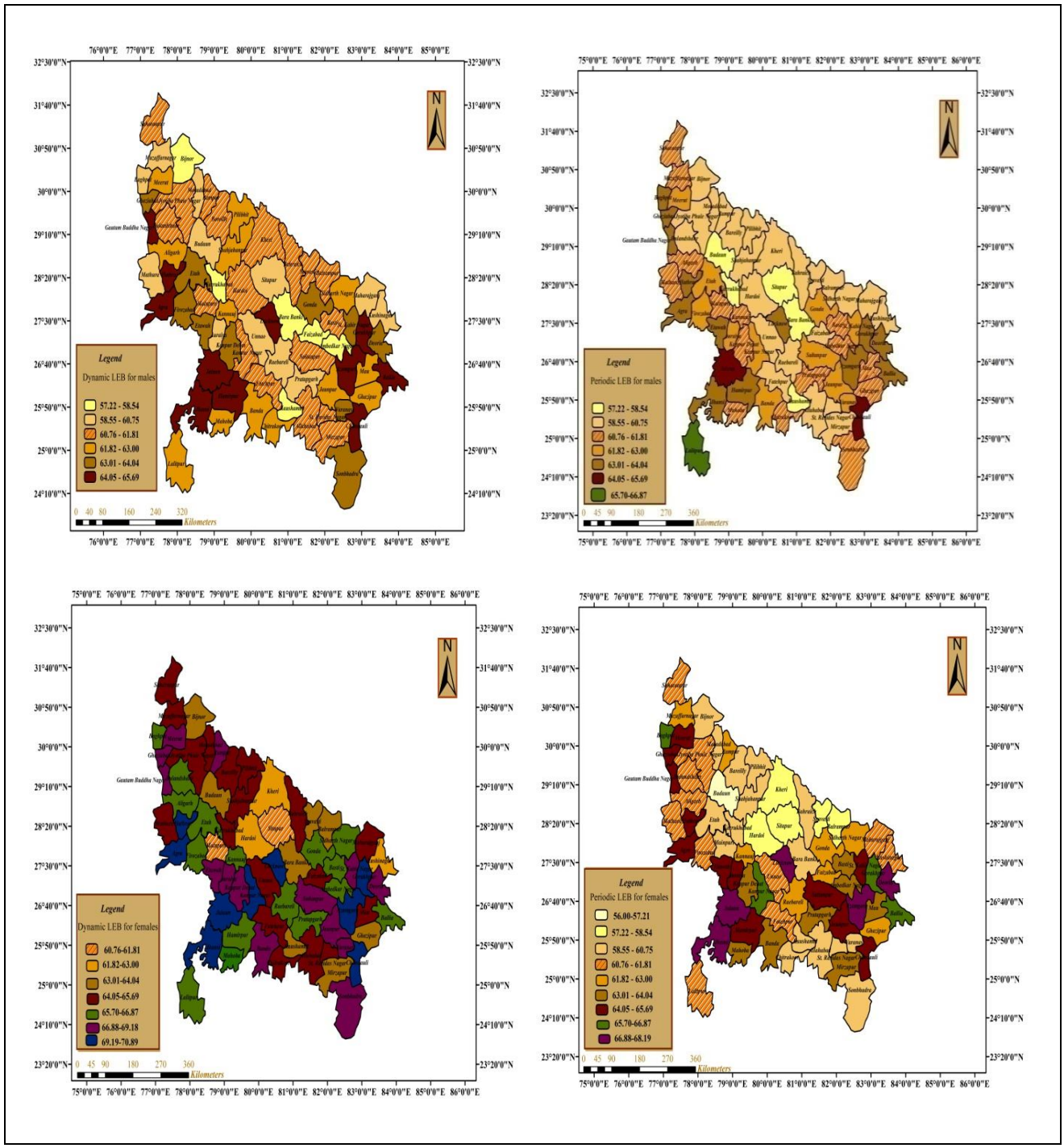
Source: Table 1

Figure 2: Map showing dynamic and periodic LEB for the districts of Kerala for both the sexes.



Source: Table 2

Figure 3: Map showing dynamic and periodic LEB for the districts of Uttar Pradesh for both the sexes



Source: Table 3

It is noteworthy to mention that people who reside in the socially disadvantaged districts are found to have a lower dynamic life expectancy at birth as compared to people from the advanced districts. As, for instance, in the Dhubri district of the state Assam, a man is expected to live for 58.21 years on an average under the dynamic consideration while in the Kamrup district for the same state the value stood at 61.59 years. Reflections of huge inter-district variation in the life expectancy estimates suggest that the transition of mortality varies widely across the districts of the individual states (Chaurasia, 2013). This variation may be attributed due to inconsistent improvement in infant and child mortality where a larger number of deaths among the children prevail mostly in marginalized and socially disadvantaged communities (Singh et. al, 2011). It is also apparent from the tables (Table 1 to Table 3) and figures (Figure 1 to Figure 3) that in almost all the districts under consideration, the dynamic expectation of life at birth is significantly higher than the usual life expectancy at birth for both the sexes. The increase in LEB under the dynamic setup is possibly due to a consecutive shrink in mortality rate which is largely the result of improved health conditions (Sharma et. al, 2017). Panigrahy (2006) also stated that the incidence of mortality has improved by increasing the awareness facilities for sanitation and cleanliness. Sharma et. al (2017) also pointed out that the growing level of urbanization in a developing country like India tends to lower the mortality rate by the availability of better health facilities and sanitation. When the probabilities of death calculated for the current year by incorporating the rate of change of the mortality of the previous year is found to be lower, life expectancy at birth under the dynamic scenario becomes higher and vice-versa. The calculation of probabilities of death under the dynamic scenario for each age group is based on the rate of the probabilities of death (Refer Appendix A2 to Appendix A4).

Conclusion

Analysis of mortality data is immensely important particularly in the Indian context where there is a wide disparity in death statistics by age, gender, and geographical regions. An examination of mortality trends over the years will assist in appraising whether the status of the health of the population is changing and also helps in monitoring the health system. The study propounds that the inclusion of dynamic consideration divulges the factual condition of mortality more explicitly by retaining the rates of change of probabilities of the usual life tables over the past years. The findings in this study highlighted the difference between the dynamic LEB and the corresponding periodic LEB deviates with the choice of the region. It is also noteworthy to mention that the difference between the usual expectation of life at birth and the corresponding life expectancy under the dynamic consideration is not consistent between the two sexes for the same region. As the burden of mortality didn't fall proportionately amongst all the districts, so a huge regional differential is spotted in the values of dynamic life expectancy and as well as the corresponding usual life expectancy. Considerably, lower life expectancies at birth particularly in the backward districts of the selected states specify asymmetrical dissemination and utilization of resources in those areas.

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Appendices

Appendix A1: Details of the newly formed districts:

 # # New districts from Assam:

Baksa district created from: Barpeta, Nalbari and Kamrup districts in 2004.

Chirang district carved out from Bongaigoan district in 2004.

Kamrup Metropolitan district was carved out from Kamrup district in the year 2003.

Udalguri district was carved out from Darrang district in 2004.

 # # New districts from Uttar Pradesh:

Kanshiram Nagar district was bifurcated from Etah district in the year 2008.

Appendix A2: Dynamic Life table for Mathura district (Uttar Pradesh) (males)

Age	***qx(2011)***	***qx(2001)***	***q(x,y)***	***l(x,y)***	***L(x,y)***	***T(x,y)***	***e(x,y)***
0	0.0733033	0.0806	0.073303	100000	94693	5972527	59.73
1	0.024023	0.0191	0.025442	92670	366279	5877834	63.43
5	0.00765	0.0066	0.008483	90312	449723	5511555	61.03
10	0.004387	0.004128	0.004718	89546	446238	5061832	56.53
15	0.005352	0.004629	0.006848	89124	443952	4615594	51.79
20	0.011469	0.011149	0.012209	88514	440193	4171642	47.13
25	0.012141	0.011541	0.01392	87433	434306	3731449	42.68
30	0.013575	0.01455	0.010872	86216	428756	3297143	38.24
35	0.015134	0.015506	0.013838	85279	423642	2868387	33.64
40	0.01965	0.0186	0.024747	84099	415613	2444745	29.07
45	0.019789	0.0196	0.020701	82018	406177	2029132	24.74
50	0.0233	0.0212	0.038077	80320	394436	1622955	20.21
55	0.0686	0.0644	0.098338	77262	368423	1228519	15.9
60	0.1135	0.1093	0.143392	69664	324571	860096	12.35
65	0.20745	0.2043	0.229845	59675	265178	535525	8.97
70+	1	1	..	45959	270347	270347	5.88

AppendixA3: Dynamic Life Table for Dhubri district (Assam) (females)

Age	*qx(2011)*	*qx(2001)*	*q(x,y)*	*l(x,y)*	*L(x,y)*	*T(x,y)*	*e(x,y)*
0	0.076169	0.084468	0.076169	100000	94485	6593764	65.94
1	0.03385	0.051616	0.0304616	92383	364195	6499279	70.35
5	0.00429	0.017424	0.0016083	89569	447338	6135084	68.50
10	0.003178	0.008716	0.0009471	89425	448561	5687746	63.60
15	0.002079	0.01022	0.0001386	89340	432737	5239185	58.64
20	0.00645	0.03018	0.0002164	89328	439007	4806448	53.81
25	0.00685	0.02342	0.0002478	89309	443785	4367441	48.90
30	0.01019	0.024584	0.0006085	89287	443607	3923656	43.94
35	0.02025	0.026084	0.0079362	89233	444417	3480049	39.00
40	0.022573	0.029088	0.0077808	88525	441161	3035632	34.29
45	0.02485	0.041464	0.0022403	87836	439218	2594471	29.54
50	0.025711	0.067012	0.0001765	87639	424895	2155253	24.59
55	0.04055	0.09726	0.0002769	87624	433323	1730358	19.75
60	0.0876	0.142556	0.0042788	87600	437342	1297035	14.81
65	0.18885	0.200988	0.1244116	87225	410440	859693	9.86
70+	1	1	----	76373	449253	449253	5.88

Appendix A4: Dynamic Life Table for Muzaffarnagar district (Uttar Pradesh) (females)

Age	*qx(2011)*	*qx(2001)*	*q(x,y)*	*l(x,y)*	*L(x,y)*	*T(x,y)*	*e(x,y)*
0	0.079049	0.08730	0.079049	100000	94277	6519520	65.20
1	0.020389	0.03732	0.017529	92095	365266	6425243	69.77
5	0.0067500	0.01052	0.004947	90481	451757	6059977	66.98
10	0.002162	0.00509	0.000774	90033	451930	5608220	62.29
15	0.007118	0.01262	0.002691	89963	449152	5156290	57.32
20	0.008392	0.01724	0.001723	89721	449493	4707138	52.46
25	0.009845	0.01812	0.001898	89566	447406	4257645	47.54
30	0.011079	0.01882	0.002035	89396	446818	3810239	42.62
35	0.013441	0.02042	0.002863	89214	444700	3363421	37.7
40	0.018382	0.02514	0.004937	88959	443596	2918721	32.81
45	0.01985	0.02881	0.003448	88520	441552	2475125	27.96
50	0.030983	0.04329	0.005441	88215	439955	2033573	23.05
55	0.054778	0.06296	0.024776	87735	433686	1593618	18.16
60	0.096606	0.10305	0.064732	85561	414877	1159932	13.56
65	0.165409	0.16205	0.189775	80022	363667	745055	9.31
70+	1	1	----	64836	381388	381388	5.88